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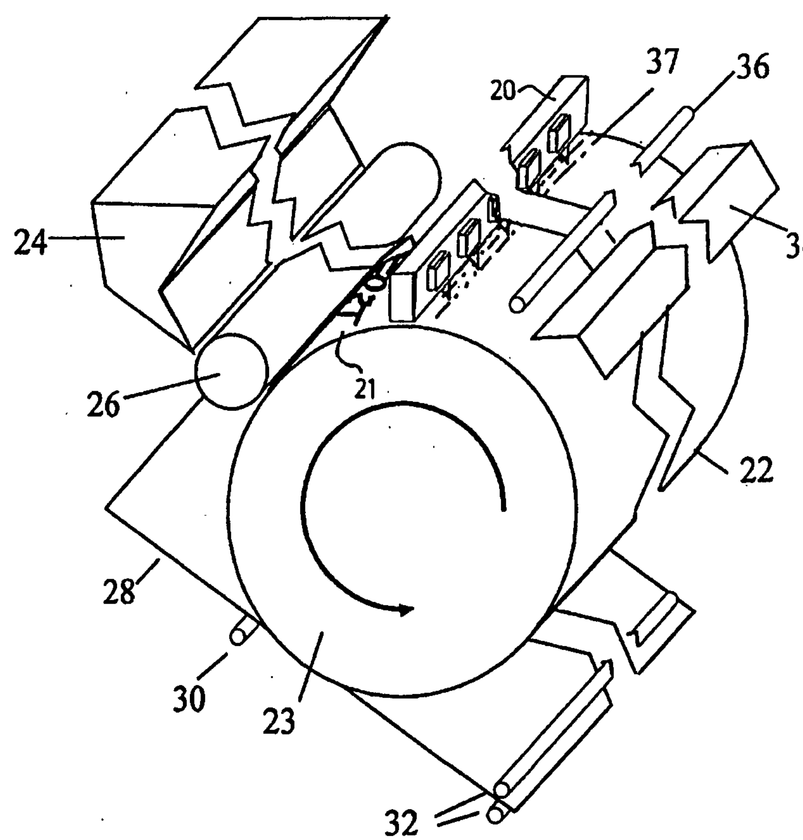
(54) Title: INTEGRATED OPTICS BEAM DEFLECTORS AND SYSTEMS

(57) Abstract

An optical switch (20) including a monolithic plurality of selectably directable optical beam deflecting devices (52, 54, 56, 58) and a plurality of optical beam receiving devices (55, 424).



waveguides 54, thereby governing the orientation of said selectably directable output beam 56. Preferably, the sequential multiplexer 58 is a phase controller which controls the phase of the light emitted by each of the multiplicity of waveguides. Alternatively multiplexer 58 may be an intensity controller or a combination phase/intensity controller. Multiplexer 58 may be on a substrate separate from or integral with substrate 52.

An input light source 60, such as a diode laser or an optical fiber, provides a light beam 62 which impinges on an input lens assembly 64, a preferred embodiment of which is illustrated in Fig. 7. The input lens assembly 64 provides a multiplicity of focused beams 65, each of which impinges on one of the waveguides 54 on substrate 52.

As seen in Fig. 7, the input lens assembly 64 typically comprises a combination of a cylindrical lens 66 and an array of cylindrical microlenses 67 bonded thereto. The output lens 55 typically comprises mutually perpendicularly aligned cylindrical lenses 68 and 69.

Reference is now made to Figs. 3A and 3B, which illustrate two alternative embodiments of an integrated optics scanning unit forming part of the scanning engine of Fig. 2. In the embodiment of Fig. 3A, an input laser 70, such as a diode laser, receives a laser control signal from content control electronics (not shown) and provides a laser beam 72 which impinges on an input lens assembly 74, a preferred embodiment of which is illustrated in Fig. 7.

The input lens assembly 74 provides a multiplicity of focused beams 76, each of which impinges on one of the waveguides 54 on substrate 52. Each waveguide 54 receives an electrical input via a corresponding conductor 78, which extends from the waveguide to a corresponding connector pad 80 which is also formed on substrate 52. A sequential multiplexer 58 (Fig. 2), formed on a separate substrate 82 receives address information via an address bus 84 and a phase, intensity, or phase/intensity input via an input line 86 from control electronics (not shown) and supplies a phase, intensity, or

phase/intensity control signal to each waveguide 54 via a conductor 88 and a corresponding connector pad 80 and conductor 78.

The phase, intensity or phase/intensity controlled outputs 90 of each of the waveguides 54 are combined in an output lens 92 and produce a focused output beam 94, whose direction is controlled by the phase, intensity or phase/intensity inputs supplied via multiplexer 58.

The embodiment of Fig. 3B is identical to that of Fig. 3A other than in that multiplexer 58 (Fig. 2) is not embodied on a separate substrate from that on which the waveguides 54 are formed, as in Fig. 3A. In the embodiment of Fig. 3B, waveguides 54 and sequential multiplexer 58 are both embodied on a single substrate 100 and thus connector pads 80 may be eliminated. The remaining elements of Fig. 3B may be identical to those in Fig. 3A and are indicated by the same reference numerals.

According to an alternative embodiment of the present invention, input and output lenses 74 and 92 may be eliminated. Other types of optical couplers, known in the art, may be employed instead.

Reference is now made to Fig. 4, which is a simplified illustration of optical switching apparatus constructed and operative in accordance with a preferred embodiment of the present invention. The optical switching apparatus preferably comprises an optical interconnect unit 110 which is connected to a multiplicity of ports 112, most or each of which has a data output line 114, an address output line 116 and a data input line 118, as well as a, preferably duplex, information conduit 120 which can be of any suitable form, such as, for example, copper or fiber and which can receive data in any suitable format. Some of the ports 112 may lack a data input line or may lack a data output line and an address output line.

When optical fibers are employed as data output lines 114, it is preferred that polarization maintaining fibers be employed in conjunction with polarized lasers or other polarized light sources. This eliminates polarization sensitivity of the beam deflection.

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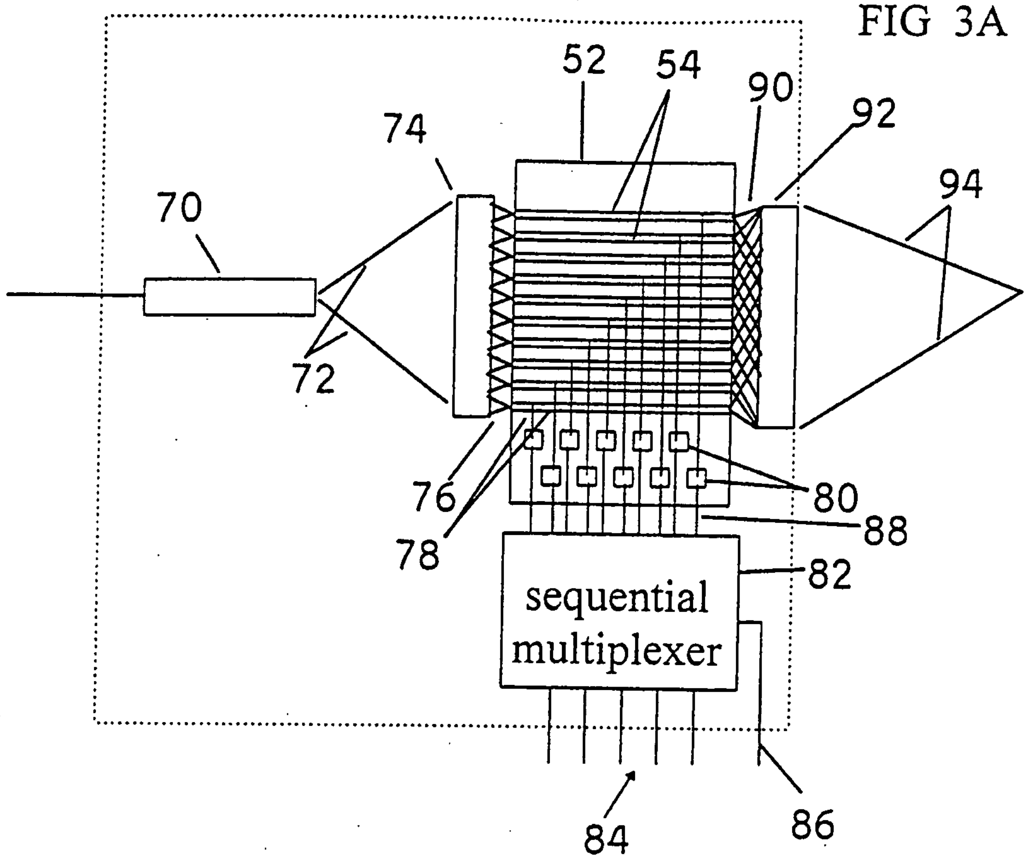

FIG 3A

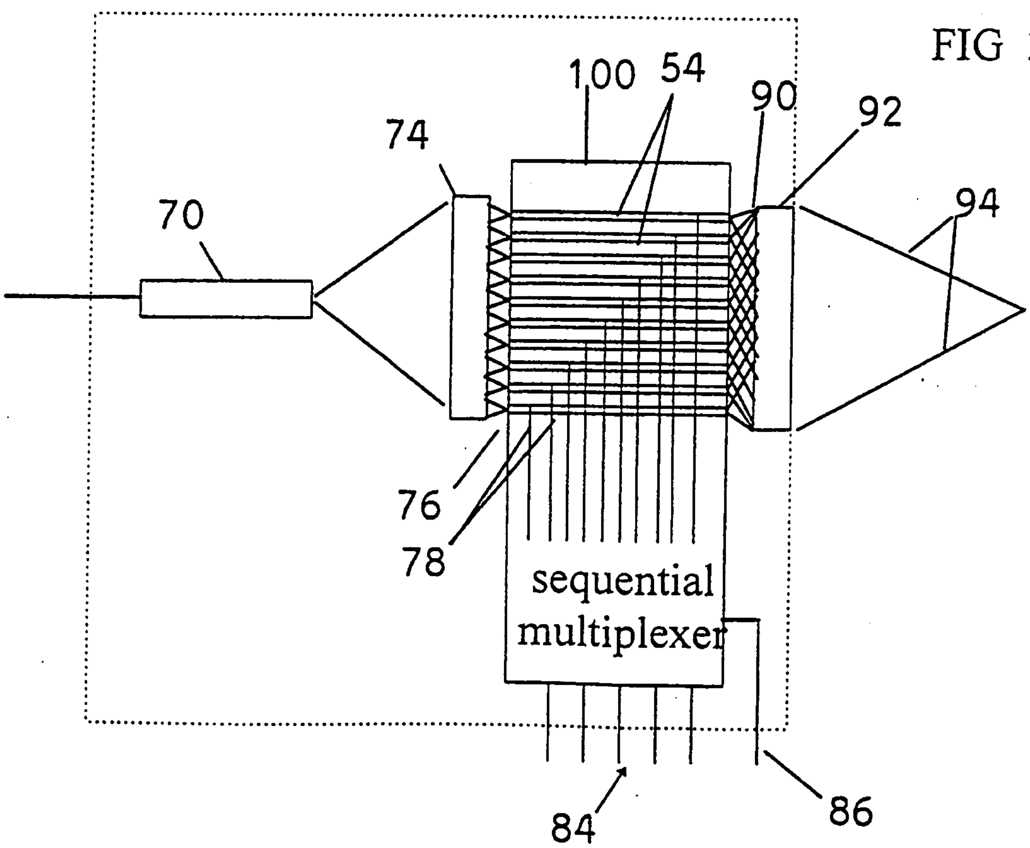

FIG 3B